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Manure- Valuable Soil Builder

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MANURE . . .

Valuable Soil Builder

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GOOD FARMERS for years have considered the manure produced on their farms a valuable fertilizer and many carefully conducted experiments have shown that these farmers have been right.

Here are some of the highlights of the value of manure which have come from our experiments at the Iowa Station, from experiments elsewhere and from calculations:

1. The manure produced on an average quarter section farm in Iowa is worth as much as the combined value of the oat and hay crops of the farm, or one-third the value of the corn crop.

2. The manure produced in the barns and lots has a crop producing value four times that of the limestone and commercial fertilizer used on the average Iowa farm.

3. On a highly fertile, dark-colored soil (Webster) at the Agronomy Farm at Ames, manure has been applied over a 30-year period at the rate of 8 tons to the acre once each 4 years in a 4-year rotation of corn, corn, oats and clover-timothy hay, and it has increased the value of the four crops in the rotation $19.12 an acre using 10-year average prices. Each ton of manure had an actual value of $2.39 in increasing the crop yields.

4. Manure applied to less fertile soils than the Webster has given even better yields, and its value per ton is higher when applied in amounts smaller than 8 tons per acre each 4 years.

5. The organic matter has declined only a third as fast where manure has been applied to soils as where it hasn't in plots at the Agronomy Farm of the Iowa Station. This was over a 20-year test period. Organic matter gives the soil its life, prevents it from baking and becoming cloddy, gives it capacity to hold water and makes more plant food available.

Hauling manure directly from the barn and spreading it on fields where it will be plowed under immediately aids in preserving its soil-building properties. Where manure is piled outside with no protection, the losses from leaching and firing greatly reduce its fertilizing value.

6. Because manure increases yields, the same amount of labor and power used in preparing the seedbed, planting, tending and harvesting a crop will give more bushels of grain or more tons of hay. Applying manure makes it possible to produce the same amount of crop from fewer acres.

7. A ton of well-preserved, mixed manure (bedding and droppings of animals) contains plant food equal to about 100 pounds of a 10-5-10 commercial fertilizer; that is, 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash.

8. Manure helps prevent soil erosion by making the soil able to absorb more of the water which falls on it so that less water runs off. It also stimulates plant growth, which slows down surface runoff and favors water absorption.

9. Manure alone is not enough on most Iowa soils. Many of them are acid and need lime to grow legumes. Addition of phosphate fertilizer with manure and limestone is highly profitable on many Iowa farms. On sloping soils, contour tillage is essential.

Manure's Importance

Livestock on the average 160-acre Iowa farm produces about 280 tons of manure each year. Of this, 240 tons are available for cropland and the remainder falls on permanent pasture. Perhaps 1/3 of that available for cropland is dropped directly in the fields and the remainder, 160 tons, is dropped in the barns and lots. On the basis of its ability to increase crop yields, a ton of manure is worth about $2.40 using 10-year average prices. In terms of crop-producing value the average Iowa farm produces manure worth $570.

This same average Iowa farm produces a $1700 corn crop, a $240 oat crop and a $240 hay crop. Accordingly, the crop-producing value of manure, when unwasted, is more than equal to the value of the hay and oat crops combined or to 1/3 the value of the corn crop. It is worth 1/8 of the value of all livestock on the average Iowa farm Jan. 1, 1945.

It Adds Plant Food and Helps to Make the Nutrients Already in the Soil Available

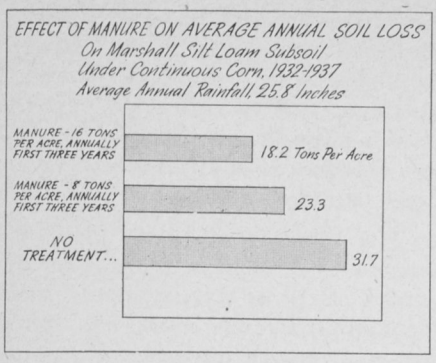

Fig. 1.

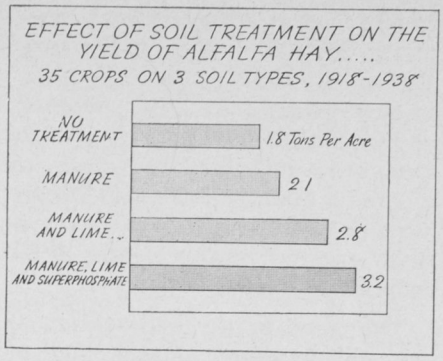

Fig. 2.

A rough estimate of the amount of manure produced on an Iowa farm can be easily made from the weight of crops fed. At the Ohio Agricultural Experiment Station, an average of 1.5 pounds of manure was produced for each pound of crops fed or used as bedding. This manure was all carefully saved and kept under excellent storage conditions. This quantity is not saved on the average Iowa farm. Actually the loss from manure dropped in the barns and lots through heating and leaching is more than 50 percent on most Iowa farms. With reasonably good care, 1.0 pound of manure should be available for each pound of crops used on the farm. This method of calculation along with estimates based on the numbers of different kinds of livestock were used in the above comparisons.

The importance of manure can also be illustrated by comparing its crop-producing value with that of limestone and mineral fertilizer. The manure produced in the barns and lots has a potential crop-producing value equal to four times that of the fertilizer and limestone used in 1944 on the average Iowa farm.

Increases Crop Yields

The ability of manure to increase the yield of crops has been recognized for centuries. Manure helps even good productive soils. The effects of manure have been studied since 1915 on Webster soil, a dark, highly fertile soil at the Agronomy Farm at Ames. A 4-year rotation of corn, corn, oats, and clover-timothy hay was followed. Part of the plots received no treatment. Others received an application of 8 tons of manure once each rotation. The manure was applied to the clover sod and plowed under for corn.

This rate of manuring is practical on livestock farms where the yields of corn and oats are 65 bushels per acre and hay yields 2.75 tons per acre. Actually, if all of the crops were fed, about 12 tons of manure would be produced per acre per rotation. With good management and allowing for some sale of crops, 8 tons could be saved to apply to the land. On most Iowa farms the amount of manure produced will be appreciably less than this. Moreover, as much as 50 percent of the value is easily lost by careless handling.

While good yields were obtained without any treatment other than a good rotation, manure (see table 1) increased the yield of all crops even though the soil on which it was used was very fertile. The yield of corn was increased an average of 10.8 bushels per acre; oats, 3.7 bushels per acre; and clover hay 0.58 ton.

Clover Increase Largest

Surprisingly enough, the largest percentage increase in yield was obtained on the clover hay. Though the manure was applied ahead of the corn, the clover crop was increased 27 percent while the corn showed a 20 percent increase in yield. Similar results have been obtained in other experiments.

In this experiment, the manure resulted in increased crops worth $19.12 per acre per rotation according to calculations based on average farm prices for the period of 1934-1943. Each ton of manure produced increased crops worth $2.39. On less fertile soils even greater values than this are obtained. Also, manure applied at lower rates per acre usually gives larger increases per ton of manure.

The use of manure and other soil fertility and conservation practices means more production per acre; more food produced per farm; lowered production costs. On the basis of the data shown in table 1, 84 acres of land receiving manure will produce as much food as 100 acres without manure. Wise use of available manure allows greater production on the same number of acres.

Aids in Erosion Control

Manure is a big aid in decreasing soil erosion. Two of the primary causes of erosion are the loss of soil organic matter and insufficient vegetative protection. Ma-

TABLE 1. EFFECT OF MANURE ON THE YIELD OF CROPS IN A 4-YEAR ROTATION, WEBSTER SERIES, AGRONOMY FARM, 1915-1938.

Crop*	Yield per acre		Increase per acre when manured		
	No manure	8 tons manure**	In yield	Percent	In value***
Corn (bu.) (1st Yr.)	56.1	67.9	11.8	21.1	$7.08
Corn (bu.) (2nd Yr.)	51.4	61.1	9.7	19.1	5.82
Oats (bu.)	60.0	63.7	3.7	6.2	1.29
Clover (tons)	2.12	2.70	0.58	27.3	4.93

*Includes 23 corn crops (1st yr.), 23 corn crops (2nd yr.), 23 oat crops and 19 clover crops.
**Manure applied on the clover sod.
***Based on average farm prices for 1934-1943; corn 60c per bushel, oats 35c per bushel, clover hay $8.50 per ton.

nure contributes towards the solution of both of these problems.

As shown in table 3, manure helps to slow up the decline in soil organic matter. This is done in two ways, by direct additions to the supply and by stimulating more plant growth. Improvement in plant growth also furnishes a more effective canopy of leaves and stems, which breaks the fall of the raindrops, thus slowing up surface runoff, increasing absorption and decreasing erosion.

Although manure can generally best be used for corn, there are badly eroded knolls and hillsides where it may have more value in establishing stands of legumes and grasses. It may mean the difference between success and failure in getting a good stand. It takes a good legume grass sod to control erosion on these areas.

The effect of heavy applications of manure on soil losses on Marshall silt loam subsoil under continuous corn is shown in fig. 1. In this experiment, manure was applied at rates of 8 and 16 tons per acre per year for each of 3 years. During the next 3 years the plots were continued without manure additions in order to study the residual effects. In view of the abnormally heavy rates—24 and 48 tons in 3 years—the average annual soil losses for the 6-year period are used.

It is evident that the addition of manure brought about a significant reduction in soil loss. Similar trends were also noted in surface runoff. The first 8-ton was somewhat more effective than the second 8-ton addition.

Slows Depletion

Manure slows the decline of soil organic matter. This is well illustrated by the data in table 3. On the Agronomy Farm fertility plots at Ames, several rotations and soil treatments have been studied continuously since 1915. In 1917 and 20 years later, in 1937, soil samples were obtained to study the effects of the various treatments on the soil.

The organic matter content of the soil declined under all systems of management, but much more rapidly under some systems than under others. Manure greatly slowed up the decline in organic matter depletion. Under continuous corn the decline with manure was only one-third as great as where no manure was used. Where manure was used in a 4-year rotation, organic matter losses were reduced to a very low level.

The trend in nitrogen content of the soil followed closely that of the organic matter, as might be expected since nitrogen is an essential part of soil organic matter or humus. In Iowa soils the organic matter contains close to 5 percent of nitrogen.

The advantages of a soil well supplied with organic matter are well recognized. When a soil loses its organic matter, it becomes lifeless, runs together badly, bakes and becomes cloddy, loses its moisture-holding capacity and becomes lower in available plant food. A good supply of active organic matter is necessary in maintaining soil fertility.

Returns Plant Food

The ability of manure to increase crop yields is due largely to its content of nitrogen, phosphorus and potassium. A ton of well-preserved mixed manure contains plant food nutrients equal to about 100 pounds of a 10-5-10 fertilizer; that is, 10 pounds of nitrogen, 5 pounds of phosphoric acid and 10 pounds of potash. At present prices the total plant food in a ton of manure would cost about $2.32 if bought in commercial fertilizer. One should remember, however, that the plant food in manure is somewhat more slowly available than that in mineral fertilizer. A number of experiments have shown that the benefit of manure is distributed over a long period of time.

The amount of plant food returned to the soil in manure influences fertilizer requirements and consumption. In Iowa, the number of livestock units is the largest of any state in the nation. Accordingly, the amount of manure produced is proportionately large.

As shown in table 2, 372,000 tons of plant food are returned to cropland in Iowa annually, assuming that 60 percent of that available in manure is returned. This is over 15 times the plant food contained in commercial fertilizers sold in Iowa in 1944. Careless handling of manure results in losses of plant food equal to several times that contained in commercial fertilizers sold in 1944.

Manure Alone Not Enough

Manure alone is not a complete soil treatment. Most Iowa soils are acid and are improved by applying lime. On many soils, phosphate fertilizer and other mineral fertilizers are also needed for best results.

The need for a combination of soil fertility treatments is illustrated in fig. 2. Although manure alone increased the yield of alfalfa, the addition of lime and superphosphate increased it still further. In these experiments, manure was applied on the average at the rate of 2 tons per acre per year for the

Below is shown a comparison of clover with and without manure, side by side. At left the plot had no treatment and yielded 0.87 ton per acre. At the right, 10 tons of manure was added each 5 years and yielded 1.98 tons per acre in a 5-year rotation of corn, corn, oats and 2 years hay.

TABLE 2. PLANT FOOD CONTENT OF MANURE AND COMMERCIAL FERTILIZER IN IOWA, 1944.

Item	Total amount in tons	Estimated plant food in tons
Commercial Fertilizer	99,900	24,700
Manure—Total available for cropland	50,000,000	620,000
Manure—Assuming 60% is saved and used on cropland	30,000,000	372,000

corn crop in the rotation. Limestone was used in sufficient amounts to neutralize soil acidity. Superphosphate was used at the rate of 120 pounds per acre of a 20 percent material to all grain crops in the rotation.

The use of manure is, therefore, only one phase in a sound soil fertility and conservation program. It gives best results when used as a part of a good soil management program including adequate drainage, adapted crop rotation, liming of acid soils, use of commercial fertilizers, and contour farming and terracing on sloping soils.

Handling, Storing Manure

Careless handling and storing of manure often results in large losses. Greater returns can be obtained by:

1. Using sufficient bedding in barns and sheds to insure absorption of the liquid.

2. Hauling directly from the barns to the fields whenever possible. It should be plowed down or disked in as soon as possible, especially on sloping land.

3. Storing under a roof and on a water-tight floor. Manure keeps best when well compacted. Cattle sheds are ideal storage places.

4. Spreading ahead of corn.

5. Applying lightly. Greater returns per ton are obtained than with heavy applications. One should plan to cover all of the corn acreage.

6. Applying evenly.

Penicillin for Mastitis

Research is under way at various institutions with the use of the new drug, penicillin, for the cure of mastitis in dairy cows. The results reported have been promising.

The University of Illinois has reported that of 44 infected quarters treated, approximately 60 percent were cured after one treatment; seven quarters required two treatments and three quarters required three treatments. Only seven infected quarters (about 15 percent) remained infected after three separate infusions of penicillin. In this experiment 14 of 18 treated cows were cured.

Experiments with penicillin for mastitis are under way now at the Veterinary Research Institute of Iowa State College. Results of this work will be reported later.

Only six soybean strains out of a total of 3,000 tested at the Iowa Station in the period from 1937 to 1942 were sufficiently promising to warrant further trial. These selections will probably not be released as varieties but will be used as parents in the attempt to breed their desirable qualities into new varieties.

TABLE 3. EFFECT OF MANURE ON THE ORGANIC MATTER CONTENT OF THE SOIL

Clarion Series, Agronomy Farm, for 20-year Period From 1917 to 1937

Cropping system	Manure treatment	Average loss of organic matter	
		lb. per acre	percent
Continuous corn	None	18,100	18.9
	8 tons in 4 yrs.	5,400	6.2
Modified 4-yr. rotation (corn, oats, legume hay, wheat and 5 yrs. alfalfa in 25).	None	8,600	10.2
	8 tons in 4 yrs.	1,200	1.5

"Pep" Bluegrass Pastures

EXPERIMENTS conducted by the Iowa Station at the Pasture Improvement Farm, Albia, point the way to making bluegrass pastures produce more feed.

Two treatments of 5-acre pastures were compared side by side with untreated pastures. The check pastures (all of the treatments were in duplicate) received no treatment. Two pastures were treated with 3 tons of limestone per acre, heavily disked and reseeded to a mixture of clovers and lespedeza. The third set of pastures was limed, disked and reseeded in the same manner and in addition fertilized with phosphate.

Steers were then put on these pastures to determine the number of days of grazing that the pastures would stand and how much "beef" each would produce.

The pastures without treatment gave an average of 83½ days of grazing and the gain of the steers was 97.5 pounds each. In comparison, the pastures limed, disked and reseeded to the clover-lespedeza mixture gave an average of 111½ days of grazing and produced 143 pounds gain of weight per steer. This decided increase was obtained the first year after treatment in which the bluegrass sod was drastically torn up.

The steers on the pastures that were limed, disked, reseeded and given phosphate fertilizer treatment did not gain as well as those on pastures not given phosphate the first year, but in 1945, the second year after treatment, the pastures with phosphate showed a decided advantage over those limed, disked and reseeded only.

These tests point out clearly that liming, disking and reseeding with clovers and lespedeza can greatly improve southern Iowa pastures.

The clover-lespedeza mixture consisted of 5 pounds biennial white sweetclover, 3 of medium red clover, 2 of alsike and 10 of Korean lespedeza. Lime was applied in the fall and all pastures to be reseeded were springtoothed and heavily disked in the fall. The phosphated pastures received 250 pounds of 20 percent superphosphate in the spring.